732
H68
P72

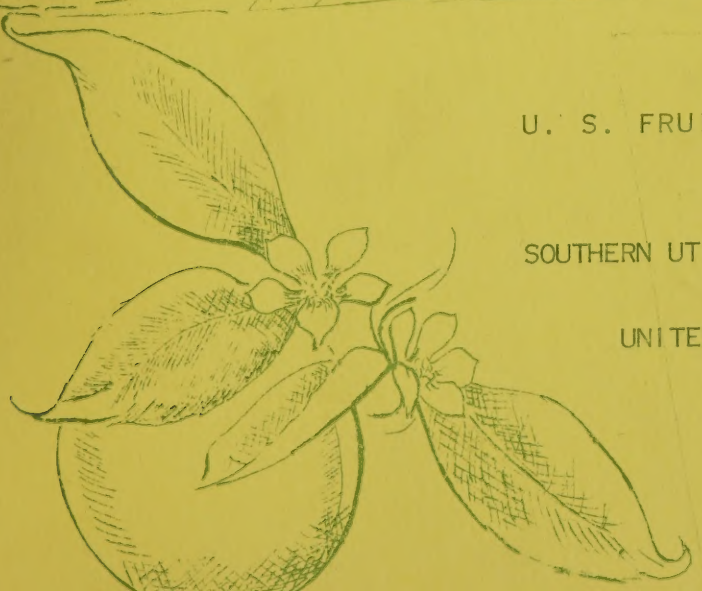
CITRUS

PROCESSING CONFERENCE

OCTOBER 7, 1958

LIBRARY
CURRENT SERIALS
OCT 2 - 1958
U. S. DEPARTMENT OF AGRICULTURE





U. S. FRUIT AND VEGETABLE PRODUCTS LABORATORY
WINTER HAVEN, FLORIDA

SOUTHERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION
AGRICULTURAL RESEARCH SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE

PROGRAM AND ABSTRACTS OF PAPERS

EIGHTH CITRUS PROCESSING CONFERENCE

October 7, 1958

Florida Room, Citrus Building
Winter Haven, Florida

It would be appreciated if no part of any abstract in this Program and Abstracts of Papers is reproduced or used without consulting the author or organization concerned. The abstracts were prepared for the benefit of those attending the conference and are not available for general distribution.

ORGANIZATIONS PARTICIPATING IN
EIGHTH CITRUS PROCESSING CONFERENCE

SOUTHERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION
U. S. Fruit and Vegetable Products Laboratory, Winter Haven, Florida
U. S. Fruit and Vegetable Products Laboratory, Weslaco, Texas

WESTERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION
U. S. Fruit and Vegetable Laboratory, Pasadena, California

PROGRAM - - - CITRUS PROCESSING CONFERENCE
(October 7, 1958)

MORNING SESSION - 10:00 A.M.

(M. K. Veldhuis, In Charge, U. S. Fruit and Vegetable Products Laboratory, Winter Haven, Florida, Presiding)

OPENING REMARKS. M. K. Veldhuis

Page

EFFECT OF CITRIC ACID CONCENTRATION ON THE FORMATION OF DIACETYL BY LACTOBACILLUS BREVIS 3
N. B. Rushing and Vincent J. Senn,
U. S. Fruit and Vegetable Products Laboratory,
Winter Haven, Florida

RESIDUAL STORAGE LIFE AND STUDIES ON MECHANISMS OF CLOUD LOSS IN FROZEN CONCENTRATED ORANGE JUICE 5
Theo. J. Kew and Vincent J. Senn,
U. S. Fruit and Vegetable Products Laboratory,
Winter Haven

MATERIALS BALANCES IN THE CONCENTRATION OF ORANGE JUICE..... 7
W. Clifford Scott and Donald A. Morgan,
U. S. Fruit and Vegetable Products Laboratory,
Winter Haven

NOTES CONCERNING NEW U. S. FRUIT AND VEGETABLE PRODUCTS LABORATORY..... 9
M. K. Veldhuis
U. S. Fruit and Vegetable Products Laboratory
Winter Haven

AFTERNOON SESSION - 1:30 P. M.

(V. H. McFarlane, Chief, Food Crops Laboratory, Southern Utilization Research and Development Division, New Orleans, Louisiana, Presiding)

Page

PROGRESS REPORT ON THE STUDY OF CAROTENOGENESIS IN COLORED GRAPEFRUIT 11
A. E. Purcell
U. S. Fruit and Vegetable Products Laboratory, Weslaco, Texas

RESEARCH ON LEMON OIL AND CITRUS FLAVONOIDS AT THE U. S. FRUIT AND VEGETABLE LABORATORY IN PASADENA, CALIFORNIA..... 12
W. L. Stanley, R. M. Ikeda, and R. M. Horowitz
U. S. Fruit and Vegetable Laboratory, Pasadena, California

ADDITIONAL CONTENTS

LIST OF CITRUS PUBLICATIONS (SEPTEMBER 1, 1957 - AUGUST 31, 1958 INCL.) OF UTILIZATION AND DEVELOPMENT LABORATORIES

U. S. FRUIT AND VEGETABLE PRODUCTS LABORATORY, WINTER HAVEN, FLORIDA..... 13

U. S. FRUIT AND VEGETABLE PRODUCTS LABORATORY, WESLACO, TEXAS..... 14

U. S. FRUIT AND VEGETABLE LABORATORY, PASADENA, CALIFORNIA..... 14

EFFECT OF CITRIC ACID CONCENTRATION ON THE FORMATION OF DIACETYL BY LACTOBACILLUS BREVIS

N. B. RUSHING AND VINCENT J. SENN
U. S. Fruit and Vegetable Products Laboratory
Winter Haven, Florida

Lactic acid bacteria have been associated with the type of spoilage of orange juice or concentrate known as "buttermilk off-flavor". This off-flavor is characterized by the presence of diacetyl. Growth rates of strains of Lactobacillus brevis, L. plantarum. var. mobilis, Leuconostoc dextranicum, and L. mesenteroides isolated from concentrates with this type of spoilage have been previously reported.

Diacetyl formation by these species differed widely when grown in 20° Brix concentrate sealed in 4 oz. cans stored at 21° C. L. brevis grew best and produced the most diacetyl (360 ppm.). On the basis of these results L. brevis was selected for further investigations on factors controlling the rate of diacetyl formation and destruction.

Nutrient broth (pH 3.8) cultures of L. brevis produced only traces of diacetyl unless citrate or pyruvate ions were present. Citrate at 0.01 M and .02 M pyruvate resulted in 55 ppm maximum diacetyl each. The addition of lactic, malic, succinic, and fumaric acids, all of which are possible sources of pyruvic acid, failed to produce diacetyl. Glucose, fructose, and sucrose also failed to produce diacetyl when added to the basal medium. Citrate and pyruvate were the only ions found that were precursors of diacetyl. No known components of orange juice were found to be precursors, and of the enzyme inhibitors tried, none would preferentially inhibit either diacetyl synthesis or growth.

Some experiments were made with L. plantarum var. mobilis, Leuconostoc dextranicum, and L. mesenteroides in nutrient and semisynthetic broths. In any medium in which growth occurred, L. plantarum var. mobilis formed diacetyl. Difficulties were encountered with the growth of the Leuconostoc species in the different non-citrus media at pH 3.8.

Growth and diacetyl formation by L. brevis were determined in synthetic broth and filtered orange juice at different citric acid levels. Plotting these factors against percent citric acid in both broths produced ascending straight lines as the citric acid was increased from 1 to 4 percent. Below 1 percent citric in synthetic broth more diacetyl was produced per unit amount of citric acid while above 3 percent citric in filtered orange juice less diacetyl was formed per unit amount of citric. Maximum growth and peak diacetyl content was plotted in each case. Utilization of the diacetyl by the organism caused a rapid decrease in diacetyl after the maximum was reached while growth continued for some time.

Following is a table giving maximum growth and diacetyl values.

TABLE I

Maximum populations and diacetyl as a function of citrate level

	Filtered orange juice		Synthetic broth	
Citric (%)	Growth (million)	Diacetyl (ppm)	Growth (million)	Diacetyl (ppm)
.0	-	-	108	trace
.1	-	-	45	15
1.0	64	62	143	124
2.0	157	215	430	202
3.0	282	375	-	-
4.0	360	445	730	360

Maximum growth was found in the synthetic medium, but maximum diacetyl occurred in filtered orange juice. It appears likely that some factors stimulating diacetyl synthesis were relatively more limiting in the synthetic medium than in filtered orange juice.

RESIDUAL STORAGE LIFE AND STUDIES ON MECHANISMS OF CLOUD LOSS IN FROZEN CONCENTRATED ORANGE JUICE

THEO. J. KEW AND VINCENT J. SENN
U. S. Fruit and Vegetable Products Laboratory
Winter Haven, Florida

This work was undertaken to determine the effect of exposure to several time-temperature combinations on the length of time frozen concentrated orange juice will retain its quality in the household refrigerator (40° F.). This work differs from former storage studies in that the criterion of the effects of abuse is the residual storage life and not the effects apparent upon immediate examination. Shelf life was determined at 40° F. before and after storage. For purposes of this study, shelf life is the time the concentrate may be stored at 40° F. and reconstituted to give a stable cloud when examined visually after an additional 24 hours at 40° F.

The initial shelf life of lots of commercial concentrate secured during the 1956-57 season ranged between 2 and 34 days. Sub-lots of these concentrates have been stored for a total of one year at preselected combinations of temperatures from -4° to 20° F. Results obtained with a sub-lot of lot "C", which had an initial shelf life of 13 days, may be considered as typical. At the end of a year's storage at a combination of the several temperatures (20° for 1 month, 15° for 1 month, 10° for 3 months, 5° for 3 months, and -4° for 4 months), seven cans of this sub-lot were placed at 40° F., and one can withdrawn for examination daily. The results are presented in Table I. Shelf life had been reduced from 13 to 5 days during storage.

TABLE I

Determination of residual shelf-life of a sub-lot of lot "C"

Days @ 40° F.	Colorimeter Reading (%T)	Bentonite Equiv. °/oo	Visual Score 24 hrs.	48 hrs.
0	18.5	4.2	4@	4
1	15.0	5.2	4	4
2	20.5	3.8	4	4
3	16.5	4.7	4	4
4	17.5	4.5	4	4
5*	20.5	3.8	4	4
6	23.0	3.4	3	3
7	34.0	2.3	3	3

* Shelf life for this sub-lot from visual scores.

@ Full cloud is assigned a value of 4, slight clarification of 3, definite clarification of 2, and extreme clarification of 1.

Due to the low temperatures of the past winter and the widespread occurrence of freeze-damaged fruit, additional lots of commercial frozen concentrated orange juice were secured over the 1957-58 season. Unstabilized, 35° Brix, partially concentrated orange juice was obtained from commercial sources and processed in the pilot plant to 42°, 53 1/3°, and 58° Brix. Sufficient quantities of each were prepared to permit extended studies of flavor stability.

Since pectin is primarily responsible for stabilizing cloud in citrus juices, water-soluble pectin was determined on the concentrates as received, and also after severe degradation. It is believed that quality, as well as quantity, of the pectin may be important. An estimate of the average size of the water-soluble pectin molecule was obtained by viscosity measurements. In every case a decrease was observed both in the amount of water-soluble pectin and in its intrinsic viscosity after cloud loss. The results obtained for lot "D" are presented in Table 2 as illustrative.

TABLE II

Changes in water-soluble pectin on degradation

	Initial	After Degradation	Decrease (%)
Water soluble pectin, % AGA*	0.118	0.047	60
Intrinsic viscosity	5.65	1.71	70

* Anhydrogalacturonic acid

Other samples showed decreases in water-soluble pectin ranging from 43 to 85 percent and decreases of 43 to 88 percent in intrinsic viscosity.

MATERIALS BALANCES IN THE CONCENTRATION OF ORANGE JUICE

W. CLIFFORD SCOTT AND DONALD A. MORGAN
U. S. Fruit and Vegetable Products Laboratory
Winter Haven, Florida

Differences between total soluble solids in the product of concentrate plants and total soluble solids purchased, have given rise to the opinion in industry that considerable losses of fruit solids take place in processing. In preparation for a study of this problem in a commercial plant, an investigation of materials balances was undertaken in the laboratory, using a glass vacuum evaporator in which both the feed juice and product could be accurately weighed. Properties which were measured in both single strength and concentrate juices included titratable acidity, Brix by pycnometer, Brix by refractometer, soluble solids and total solids by vacuum drying. Each of these properties was evaluated as a basis for calculating apparent gain or loss of solids during evaporation.

A series of eleven evaporations was made using juice containing graduated levels of pulp from early season unfrozen oranges and from lightly damaged Queen oranges, and centrifuged mid-season juice from a processing plant. Materials balances calculated from each method of evaluation fell within 2 percent of product weights, except that refractometer balances varied as much as 4 percent. This indicates that titratable acidity, pycnometer Brix, total solids or soluble solids by vacuum drying are reasonably reliable bases for calculating materials balances. Refractometer values give only slightly less reliable balances.

Following the laboratory tests, a materials balance study was made on a commercial orange concentrate evaporator. Samples of evaporator feed juice, cutback juice, addback concentrate, and final product were collected continually over a 72-hour cleanup-to-cleanup operation, and brought to the laboratory for analyses. Records were kept of weights or volumes of all materials entering and leaving the various operations. It was necessary to estimate (1) addback losses (1 bbl. in 500), (2) juice remaining in blend tanks at the end of the run, and (3) sampling and broken cans of product (3 cases per shift).

The balance for the evaporating, blending, and filling operation by acid titration showed a solids loss of 1.1 percent; by refractometer solids a gain of 1.3 percent; by total solids by drying a loss of 0.5 percent; and by soluble solids by drying a gain of 0.8 percent. These results indicate that in-plant losses of fruit solids were not appreciable.

The weight of soluble solids purchased (plant records) was compared with the weight of solids found in the evaporator feed juice less solids from addback plus solids in cutback. All solids were determined as solubles by vacuum drying. The yield of solids in juice from the extractor was 6 percent less than that indicated by the records on the fruit received.

This work has demonstrated methods that are suitable for use in determining materials balances for concentrate plant operations. In the laboratory and the single plant operation observed, there were no serious losses of fruit solids between finishers and final product. These conclusions may or may not apply to other plants.

NOTES CONCERNING NEW U. S. FRUIT AND VEGETABLE PRODUCTS LABORATORY

M. K. VELDHUIS
U. S. Fruit and Vegetable Products Laboratory
Winter Haven, Florida

At the time of the 1957 Citrus Processing Conference, construction of the new U. S. Fruit and Vegetable Products Laboratory had begun and a few illustrations were shown of footings, foundation, and basement walls. In the meantime construction proceeded and the building is virtually complete. The exterior has been complete for several months. The overall construction has taken more time than would normally be required just for the building. The extra time has been needed to install furnishings, including laboratory benches, hoods, sinks, wall cabinets, glass washing equipment, autoclave, incubators, steam generators, air conditioning equipment, constant temperature rooms, frozen storage rooms, etc. The building is completely furnished. Later we will, of course, need to install experimental equipment in the laboratories and processing equipment in the pilot plant, but the basic facilities have been provided.

As was explained a year ago, the building is of split level design with the laboratory floor and basement on the north side and the pilot plant on the south. The main chemical research laboratories and offices are located on one floor and are so arranged to facilitate fundamental investigations on a scale not possible in the old building. In addition to having nine basic laboratories, the laboratory floor has nine other inside rooms that will be used as auxiliary laboratories or offices. Some are already equipped with laboratory benches and other equipment. In one of these rooms the relative humidity is to be maintained at 60% or lower at all times for the protection and use of delicate and expensive research instruments. Another room has been designed for taste panel work, another for chromatographic work, and still another for radioactive tracer technique investigations and the like.

As one newspaper account put it, the new facilities are "....a research man's dream..... Its long line of laboratories, its long row of controlled-temperature rooms, its power units, its pilot plant for processing of fruits and vegetables, its automatic safeguards against fire and accident... they leave little for a laboratory technician or chemist or bacteriologist to desire."

We naturally feel very fortunate that these facilities are being made available to us. We are anxious to occupy them and prove their worth.

The address is 600 Avenue S, N. W., just south of Inman Park and almost directly across Highway US 17 from the new Landmark Motel and Howard Johnson restaurant. The building is readily seen on approaching the city from the north and the location is excellent.

The dedication ceremony for the new laboratory has been set for December 4, 1958. The public will have the opportunity to inspect the facilities at that time. Since some of you attending this conference may not be able to be present on December 4, we hope to arrange for the building to be open for inspection for those wishing to see it at the conclusion of the conference. Announcement will be made concerning this.

PROGRESS REPORT ON THE STUDY OF CAROTENOGENESIS IN COLORED GRAPEFRUIT

ALBERT E. PURCELL
U. S. Fruit and Vegetable Products Laboratory
Weslaco, Texas

In attempting to improve the processing quality of Texas red and pink fruit it has been found that there is a need for more knowledge about the chemistry of the carotenoid pigments and the relationship of carotenoid properties to processing characteristics.

It has been observed that the lycopene (red pigment) of the red and pink fruit reaches a maximum several months before the start of the processing season. Data have been collected for four years. The decline of lycopene began during the period of 15 August to 10 September for each year. The carotene content continued to increase until much later. The factors initiating the decline of lycopene are not known, but it is considered that time since fruit set, temperature changes or changes of day length may be responsible.

Lycopene has been found in Marsh white and Duncan white grapefruit of Texas and Florida. This indicates that the ability to synthesize these pigments existed before mutation to colored varieties.

It is possible that the chemical difference between white and colored grapefruit is in the leaves and stems so that the colored fruit is provided with a greater abundance of carotenoid precursors than the white. It is also possible that the chemical difference lies in the fruit, per se. The lycopene content of the albedo and carpels of red and pink fruit has been measured throughout the development of the fruit. The albedo of the red fruit contains more lycopene than the carpels. The albedo of the pink fruit contains only traces of lycopene, while the carpels contain a considerable amount. This indicates that a chemical difference exists between the red and pink fruit.

The distribution of lycopene in developing red fruit is not uniform. The distribution is similar to the distribution of dye imbibed through the stem of the fruit, as though a precursor enters the fruit through the stem and is converted into lycopene by the tissues it passes through.

Biochemical studies involving the use of radio active tracers have shown that mevalonic acid is a precursor for the carotenoids. Labeled mevalonic acid injected into tomatoes is incorporated into the carotenes 10-50 times as efficiently as labeled acetic acid. Evidence has been gathered to indicate that mevalonic acid is incorporated into the carotenes through the formation of a compound which is apparently a hydrocarbon with a pair of conjugated double bonds and several isolated double bonds.

RESEARCH ON LEMON OIL AND CITRUS FLAVONOIDS AT THE U. S. FRUIT AND VEGETABLE LABORATORY IN PASADENA, CALIFORNIA

W. L. STANLEY, R. M. IKEDA, AND R. M. HOROWITZ
U. S. Fruit and Vegetable Laboratory, Pasadena, California

Investigations have been continued on the chemistry of coumarin and psoralen compounds in lemon oil. The identities of two of the compounds present in trace amounts have been established by synthesis. Examination of the expressed oils of lime, grapefruit, bitter orange, Valencia orange, and bergamot has indicated that some of the same coumarin compounds, other related compounds, and certain flavones are present in these oils. The methods of analysis previously described for detection of the addition of other citrus oils to lemon oil have been adapted to the detection of addition of the so-called "sun esters" (menthyl salicylate and beta-homomenthyl salicylate) as adulterants. It has been stated that these compounds are added to lemon oils to enhance the characteristic ultraviolet spectral absorption at 315 mμ. In the past no method was available for detecting their presence.

During the past year a study was initiated on the chemistry of the carbonyl compounds in lemon oil. By combining column chromatographic, gas-partition chromatographic, and distillation techniques the following compounds have been isolated and identified: octanal, nonanal, decanal, undecanal, citronella, geranial, and neral. A method (based on the work of Teitelbaum) has been devised for removing the mixture of carbonyl compounds from citrus oils and analyzing the mixture with a gas partition chromatographic column. This method should prove useful for determining oil characteristics and quality.

A specific colorimetric method of analysis for citral (vanillin-piperidine method) has been applied to the analysis of oil in lemon peel, to the analysis of processed lemon oils, and to an investigation of the citral losses occurring in various stages in processing lemon oils. A detailed study was made of the effect of water in contact with lemon oil in model systems and in a commercial extractor on the citral and total carbonyl content of lemon oils.

A number of additional flavonoids have been isolated from lemons since the last report. Those now identified include hesperidin, diosmin, eriodictyol, luteolin, limocitrin, chrysoeriol, isorhamnetin, quercetin, apigenin, and a new trimethoxytetrahydroxyflavone. The last mentioned compound gives 3, 5, 6, 7, 8, 3', 4'-heptamethoxyflavone on methylation. Several flavonoids which are of the catechin type, but which have not been isolated yet, have also been shown to occur in lemons. Evidence has been obtained which appears to implicate these compounds in the darkening of lemon products.

LIST OF CITRUS PUBLICATIONS
(September 1, 1957 - August 31, 1958)

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE

SOUTHERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION

U. S. FRUIT AND VEGETABLE PRODUCTS LABORATORY
600 Avenue S, N. W.
Winter Haven, Florida

THE EFFECT OF TIME AND TEMPERATURE OF PASTEURIZATION ON THE QUALITY OF CANNED CITRUS JUICES.
Kew, Theo. J.; Veldhuis, M. K.; Bissett, Owen W.; and Patrick, Roger
Agricultural Research Service Circular ARS-72-6. 17 pages.
September 1957.

FIVE-YEAR STORAGE OF FROZEN CONCENTRATED ORANGE JUICE AT -4°, 5°, and 10°F.
Kew, Theo. J.
Proc. Fla. State Hort. Soc. 70: 182-184. 1957.

*STABILITY OF FROZEN CONCENTRATED ORANGE JUICE. IV. EFFECT OF HEAT TREATMENT ON HAMLIN, PINEAPPLE, AND VALENCIA JUICES AT DIFFERENT STAGES OF MATURITY.
Bissett, O. W.; Vledhuis, M. K.; Guyer, R. B.; and Miller, W. M.
Food Technol. 11 (10): 512-515. 1957.

*STABILITY OF FROZEN CONCENTRATED ORANGE JUICE. V. THE EFFECT OF HEAT TREATMENT AT INTERMEDIATE STAGES OF CONCENTRATION ON JUICES PREPARED FROM VALENCIA ORANGES.
Carroll, E. A.; Guyer, R. B.; Bissett, O. W.; and Veldhuis, M. K.
Food Technol. 11 (10): 516-519. 1957.

---

* In cooperation with Continental Can Company, Chicago, Illinois

U. S. FRUIT AND VEGETABLE PRODUCTS LABORATORY
509 West 4th. St.
Weslaco, Texas

TEXAS PUNCH. A NEW USE FOR RED AND PINK GRAPEFRUIT
Lime, B. J.; and Griffiths, F. P.
Texas Farming and Citriculture 34 (4): 3. 1957.

SPECTROPHOTOMETRIC METHODS FOR DETERMINING PIGMENTATION - BETA-CAROTENE AND LYCOPENE - IN RUBY RED GRAPEFRUIT
Lime, B. J.; Griffiths, F. P.; O'Connor, R. T.; Heinzelman, D. C.; and McCall, E. R.
Agr. Food Chem. 5 (12): 941-944. 1957.

A LIST OF PUBLICATIONS, WITH ABSTRACTS REPORTING WORK OF THE U. S. FRUIT AND VEGETABLE PRODUCTS LABORATORY, WESLACO, TEXAS
Jones, Marie A.
Processed. 20 pages. 1957.

PRODUCTION OF CANNED PULP-FORTIFIED RED GRAPEFRUIT JUICE
Lime, B. J.; Stephens, T. S.; and Griffiths, F. P.
Agricultural Research Service Circular, ARS-72-12. 10 pages. January 1958.

CONCENTRATE FOR LEMONADE FROM MEYER LEMON JUICE
Stephens, Thomas S.
The Citrus Industry 39 (1): 16-19. 1958.

PARTITION SEPARATION OF CAROTENOIDS BY SILICA-METHANOL COLUMNS
Purcell, Albert E.
Anal. Chem. 30 (6): 1049-1051. 1958.

WESTERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION

U. S. FRUIT AND VEGETABLE LABORATORY
263 South Chester Avenue
Pasadena 5, California

FLAVONOIDS OF CITRUS II. ISOLATION OF A NEW FLAVONOL FROM LEMONS
Horowitz, R. M.
J. Amer. Chem. Soc. 79 (12): 6561-6562. 1957.

DETECTION OF FLAVANONES BY REDUCTION WITH SODIUM BOROHYDRIDE
Horowitz, R. M.
J. Org. Chem. 22 (12): 1733-1735. 1957.

SPECTRAL STUDIES ON FLAVONOLS - THE STRUCTURE OF AZALEIN.
Jurd, L.; and Horowitz, R. M.
J. Org. Chem. 22 (12): 1618-1622. 1957.

EXAMINATION OF LEMON OIL BY GAS-PARTITION CHROMATOGRAPHY
Bernhard, R. A.
Food. Res. 23 (2): 213-216. 1958.

FLUOROMETRIC DETERMINATION OF 7-GERANOXYCOUMARIN IN LEMON OIL: ANALYSIS OF MIXTURES OF GRAPEFRUIT OIL IN LEMON OIL.
Vannier, S. H.; and Stanley, W. L.
J. Assoc. Offic. Agr. Chemists 41 (2): 432-435. 1958

EFFECT OF VARIED STORAGE TEMPERATURES ON MICROORGANISMS IN FROZEN CONCENTRATED ORANGE JUICE
Wolford, E. R.
Applied Microbiol. 6 (2): 139-141. 1958.

CITRUS FLAVORS A chapter in the book FLAVOR RESEARCH AND FOOD ACCEPTANCE
Stanley, W. L.
Reinhold Publ. Co., New York, N. Y. 1958.
(Publication date August 28, 1958).

DE-BITTERING OF CITRUS FRUITS
Rockland, L. B.; Beavens, E. A.; and Underwood, J. C.
U. S. Patent No. 2,816,835; Dec. 17, 1957.
(Available from U. S. Patent Office, Washington, 25, D. C. 25¢ per copy).

STABILIZATION OF CITRUS CONCENTRATES WITH FUMARIC ACID OR ITS SALTS
McColloch, Robert J.; and Gentili, Bruno
U. S. Patent No. 2,845,355; July 29, 1958.

Reprints of the above-listed publications are available and may be obtained without cost by addressing request to the respective laboratories. Patents can be obtained only by purchase from the United States Patent Office, Washington, 25, D. C. for 25 cents each.